International Journal of Applied Research and Sustainable Sciences (IJARSS)
Vol. 1 No. 4 2023: 279 - 294

Recommendations for the Use of Ozone Technology in Post-Harvest Handling to Improve Food Security

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ARTICLEINFO

Keywords: Ozone Tecnology, Harvest, Horticulture, SWOT

Received : 11 October
Revised : 12 November
Accepted: 12 Desember

ABSTRACT

Harvest and post-harvest processes are crucial in agriculture, with ozone and irradiation technologies offering sustainable solutions to extend shelf life, reduce spoilage, and enhance food security and competitiveness. The research focuses on determining ozone's impact on vegetable freshness, providing implementation recommendations. Pattimura University's lab experiment on *Gnetum gnemon* L. leaves evaluates ozone tech for vegetable preservation. Factors include ozone dosage and treatment duration. Data will undergo univariate and SWOT analysis. Research findings indicate that applying ozone at 3 ppm for 25 minutes preserves *Gnetum gnemon* L. freshness. Implementing ozone in Ambon's food resilience involves education, infrastructure, certification, marketing, and government support.

INTRODUCTION

Handling harvest and post-harvest processes correctly is crucial in agriculture (Darwis, 2019). One of the main reasons why post-harvest handling is essential is because it can reduce yield losses. Additionally, proper post-harvest handling can also enhance the quality of the resulting products (Kifli, 2023). Adequate post-harvest processes can expand employment opportunities and increase the added value of harvested products. Therefore, farmers need to pay serious attention to post-harvest activities to ensure that the quality and quantity of the harvest can be maintained (Raheel et al., 2021). Important steps such as drying, sorting, and packaging must be carried out carefully to ensure that the final products meet quality standards and are safe for consumption. Thus, emphasis on good post-harvest handling needs to be a priority for farmers to reduce yield losses and increase the added value of agricultural products.

In order to enhance food security, one technology that can be used in post-harvest handling is ozone technology. Ozone technology is an innovation that can be utilized to extend the shelf life of agricultural products and reduce post-harvest losses (Zambre et al., 2010). Ozone can be used to kill microorganisms, prevent fungal growth, and reduce ethylene levels that accelerate the ripening of fruits (Liu et al., 2016). By implementing ozone technology, farmers can extend the shelf life of agricultural products such as fruits and vegetables, thus reducing losses due to rapidly spoiling products. The use of ozone technology can also help reduce the use of synthetic chemicals in post-harvest handling, making it more environmentally friendly (Pascual et al., 2007). This aligns with efforts to create a sustainable and environmentally safe agricultural system. Ozone technology can be an innovative solution to maintain the quality of harvests and extend the shelf life of agricultural products without using harmful chemicals.

In addition to ozone technology, irradiation technology is also a potential option in post-harvest handling of vegetables. By using irradiation technology, dried vegetables can have a longer shelf life and be safe for consumption. This technology is expected to be an efficient alternative in maintaining the quality and safety of vegetable harvests. The use of irradiation technology is also expected to support the national food security program by ensuring the availability and quality of adequate agricultural products. With the implementation of innovative and environmentally friendly post-harvest technologies, farmers can obtain high-quality and durable harvests (Hilmi, 2016). Furthermore, innovations in post-harvest handling can also help improve the competitiveness of agricultural products in both local and international markets (Lawal et al., 2019). Therefore, it is important for farmers to continue researching and adopting the latest technologies to maintain optimal quality and yield.

Moreover, it is important to pay attention to post-harvest handling procedures that are appropriate for the type of agricultural commodity (Siebers, 2011). For example, for fruits vulnerable to mechanical injury, such as bananas, careful post-harvest handling is required to avoid damaging the fruit. Thus, it is crucial for farmers to be aware of post-harvest handling techniques suitable for the commodities they produce. Consequently, the use of ozone and irradiation technologies in post-harvest handling can be excellent solutions to preserve the quality of harvests and extend the shelf life of agricultural products without using harmful chemicals. Therefore, the use of ozone and irradiation technologies in post-harvest handling is a potential choice to enhance food security and reduce waste in the agricultural industry.

To enhance food security through the use of ozone, it is crucial for farmers to have a deep understanding of how this technology can be applied in the post-harvest handling of fruits and vegetables. One important aspect to consider is the appropriate dosage and duration of ozone exposure on agricultural products. This can be achieved through consultation with ozone technology experts or specialists in this field. In the implementation of ozone, farmers need to pay attention to safety aspects to ensure that the agricultural products produced remain safe for consumption. Innovative efforts like these have significant potential in improving post-harvest handling efficiency while preserving the quality and safety of agricultural products. In this context, sustainable resources and safe food are key to the success of the future agricultural industry. Full support for environmentally friendly technologies such as ozone and irradiation will contribute to achieving these goals. With the adoption of these technologies, farmers can ensure that their harvests have added value and can compete in an increasingly competitive market.

The objective of this research is to determine the influence of ozone dosage and exposure duration on the freshness of vegetables and to provide recommendations for the implementation of ozone technology in efforts to enhance food security.

LITERATURE REVIEW

Ozone is an unstable form of oxygen consisting of three atoms (O_3) and possesses properties as a strong oxidizer with a sharp odor (Syafarudin & Novia, 2013). Ozone technology is widely used in the post-harvest management of horticultural products. The ozonation process was first introduced by Nies in 1906. Ozone has proven to be a potent disinfectant through various conducted studies. The mechanism by which ozone eliminates harmful microorganisms in horticultural products involves attacking the cell walls of microorganisms in water, causing changes in cell permeability, and ultimately leading to the lysis of bacterial cells.

Ozone-containing water can be used to wash horticultural products such as chili, making the vegetables sterile without affecting color, aroma, taste, and organic compounds present in the vegetables. Ozone can kill microorganisms in water, even at low doses of around 0.5 mg/l, making ozonation capable of rendering water sterile. Typically, ozone concentrations used in water disinfection processes range from 0.4-0.5 mg/l. A dose of 0.02 mg/l is sufficient to eliminate microorganisms such as Escherichia coli and Streptococcus faecalis. Ozone works by oxidizing the protoplasm of these microorganisms' cells (Asgar et al., 2015).

An advantage of ozone use is that the ozone absorbed into vegetable tissues will convert into oxygen when exposed to sunlight. The use of ozone in bacterial elimination is more efficient than chlorine, with a speed up to 3250 times faster (Syafarudin & Novia, 2013). Ozone formation can occur through light absorption and collision processes. In the light absorption process, oxygen gas (O_2) dissociates into two oxygen atoms when exposed to ultraviolet light with a wavelength of 240 µm. The formed oxygen atoms are highly reactive and can react with other oxygen gases, forming ozone (O_3). Collision processes can also play a role in ozone formation, where oxygen gas undergoes ionization and produces plasma, which then transforms chemical compounds into O3 (Rijal & Nur, 2015). The use of ozone at a concentration of 3 ppm for 15 to 30 minutes has been proven to reduce weight loss and sugar content in tomato vegetables (Sari et al., 2021).

METHODOLOGY

This research was conducted experimentally in the laboratory of Pattimura University using *Gnetum gnemon* L. leaves to determine the effectiveness of ozone technology in vegetable preservation. The treatments employed in this study consist of two factors. The first factor is ozone dosage (O), and the second factor is treatment duration (T). The combination of treatments in this research can be seen in the following table:

Table 1. Combination of Research Treatments

Ozone Dosage (O)	**Length of Treatment**		
	T1 (0 minutes)	**T2 (5 minutes)**	**T3 (10 minutes)**
O1 (Control)	O1T1	O1T2	O1T3
O2 (3ppm)	O2T1	O2T2	O2T3
O3 (4ppm)	O3T1	O3T3	O3T3

The ozone treatment was administered by exposing ozone in gas form according to the predetermined treatments. Subsequently, the samples were stored for 5 days, and data on deterioration after storage were then collected. The required data in this research involve the freshness of *Gnetum gnemon* L., assessed using the organoleptic data collection method. The data obtained from the experiment will be analyzed using univariate analysis, interpreted in the form of diagrams, and further analyzed using SWOT analysis. The use of the SWOT method in recommending the use of ozone technology in post-harvest handling aims to formulate precise strategies to effectively enhance food security. Through the analysis of strengths, weaknesses, opportunities, and threats, the main objective is to identify the potentials and challenges associated with the implementation of ozone technology. By emphasizing the strengths of the technology, such as its ability to extend the shelf life of products and reduce the risk of microbial contamination, recommendations can be focused on strengthening these aspects. Meanwhile, a deep understanding of weaknesses, such as high implementation costs or limited understanding on the part of farmers, serves as a foundation for developing solutions and mitigation strategies.

RESEARCH RESULT

Freshness of *Gnetum gnemon* L.

Based on the assessment by panelists regarding the freshness condition of *Gnetum gnemon L.* leaf vegetables, which has been analyzed using univariate SPSS analysis, the analytical results can be seen in the following table.

Table 2. Organoleptic Analysis Results of *Gnetum gnemon L.* Leaf Color

Strengths				
Num	Statement	Weight	Ratings	Score
1	O3 has strong antimicrobial properties, it can kill and inhibit the growth of microorganisms that cause crop spoilage.	0.2	4	0.8
2	The use of ozone can extend the shelf life of vegetables, reduce crop losses, and increase food availability.	0.15	4	0.6
3	The use of ozone can extend the shelf life of vegetables, reduce crop losses, and increase food availability.	0.18	2	0.36
4	The ozone method is natural and does not leave chemical residue on the harvest, meeting the demand for safer and more natural food.	0.2	3	0.6
	Amount	0.73	13	**2.36**
Weakness				
Num	Statement	Weight	Ratings	Score
1	Implementation of an ozone preservation system requires investment (capital) in equipment and technology, which may be prohibitive for communities with limited resources.	0.1	2	0.2
2	Limited public knowledge of ozone technology	0.1	3	0.3
3	Electricity is the main energy in the use of ozone technology for food preservation	0.07	1	0.07
	Amount	0.64	12	**1.92**

The table of organoleptic tests on the freshness of *Gnetum gnemon L.* leaves yielded significant findings related to factors influencing the level of freshness in these vegetables. The corrected model indicates that the difference in the freshness of *Gnetum gnemon L.* leaves among treatment groups is statistically significant, with a high F value (9.106), indicating the effectiveness of the model in explaining the variation in freshness. The highly significant intercept value (0.000) suggests that the difference in freshness between treatment groups occurs significantly. The factor No_Respondents has a significant influence, indicating that differences in freshness are not only due to treatment but also influenced by the individual preferences of panelists involved in the organoleptic test. This provides further context in interpreting the results, considering the subjectivity variation among panelists.

The treatment itself has a very significant impact on the freshness of *Gnetum gnemon L.* leaves, marked by a high F value (17.021). This illustrates that variations in treatment, such as ozone dosage and treatment duration, significantly contribute to the variation in the freshness of *Gnetum gnemon L.* leaves. The R-squared value of 0.618 indicates that the model can explain about 61.8% of the variation in the freshness of *Gnetum gnemon L.* leaves, demonstrating a good fit with the data. Overall, the results of this organoleptic test highlight the importance of treatment, including ozone dosage and treatment duration, in influencing the freshness of *Gnetum gnemon L.* leaves. Further information on the freshness values of *Gnetum gnemon L.* leaf vegetables for each ozone treatment can be seen in the following figure.

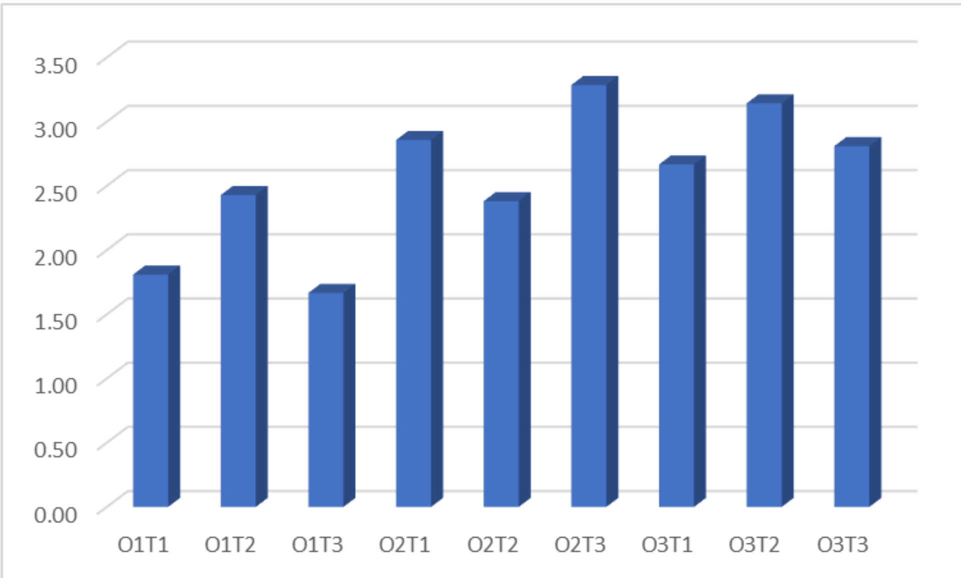

Figure 1. Organoleptic Test Graph on the Freshness of *Gnetum gnemon* L. Leaves

The above graph represents the organoleptic test on the freshness of *Gnetum gnemon* L. leaves, providing valuable information on how the use of ozone dosage and treatment duration can influence the freshness of *Gnetum gnemon* L. leaves at the end of the study. By detailing the average organoleptic ratings for each treatment, we can identify the relationship between ozone dosage, treatment duration, and the freshness of *Gnetum gnemon* L. leaves. Firstly, it can be observed that treatments with ozone dosages O2 and O3 tend to have higher average freshness ratings compared to the control O1. This indicates that higher ozone dosages may enhance the freshness of *Gnetum gnemon* L. leaves. The oxidative properties of ozone can contribute to inhibiting the growth of bacteria and decay-causing fungi, potentially leading to improved freshness.

The treatment duration variable (T1, T2, T3) also plays a role in increasing freshness. Treatments with longer durations tend to yield higher average freshness ratings. This may be due to prolonged ozone exposure, which can be more effective in killing bacteria and decay-causing fungi on the leaf surface (Nishimura et al., 2001).

Referring to the context of *Gnetum gnemon* L. vegetables receiving ozone treatment, the antimicrobial properties of ozone play a key role. Oxidation by ozone can generate reactive oxygen species that damage the cell membranes of bacteria and fungi, resulting in the death of these microorganisms (Ansiska et al., 2023). Thus, the freshness of *Gnetum gnemon* L. leaves can be maintained because the use of ozone creates an environment that is not conducive to the growth of bacteria and decay-causing fungi. Overall, the results of the above graph indicate that the use of the right ozone dosage and optimal treatment duration can enhance the freshness of *Gnetum gnemon* L. leaves in a safe and effective manner. This strategy has the potential as an environmentally friendly preservation method and can support the quality and resilience of agricultural products.

Recommendations for Ozone Technology Implementation

Based on the conducted experimental research, the use of ozone technology significantly affects weight loss and organoleptic tests (color, freshness, texture) of *Gnetum gnemon* L. leaves. Considering the results of these experimental studies, internal factors in the form of strengths and weaknesses, as well as external factors in the form of opportunities and threats, are formulated and analyzed using SWOT analysis. Subsequently, based on the internal conditions and experimental results, strategies for implementing ozone technology for preservation efforts will be formulated as a step towards improving food security in Ambon City. Internal and external factors in the implementation of ozone technology can be seen in the following table.

Table 3. SWOT Analysis of Internal Factors in the Use of Ozone Technology

Kekuatan (*strengths*)				
No	Pernyataan	Bobot	Rating	Skor
1	O_3 memiliki sifat antimikroba yang kuat, dapat membunuh dan menghambat pertumbuhan mikroorganisme yang menyebabkan pembusukan hasil panen.	0,2	4	0,8
2	Penggunaan ozon dapat memperpanjang umur simpan sayuran, mengurangi kerugian hasil panen, dan meningkatkan ketersediaan pangan.	0,15	4	0,6

3	Penggunaan ozon dapat memperpanjang umur simpan sayuran, mengurangi kerugian hasil panen, dan meningkatkan ketersediaan pangan.	0,18	2	0,36
4	metode ozon bersifat alami dan tidak meninggalkan residu kimia pada hasil panen, memenuhi tuntutan akan pangan yang lebih aman dan alami.	0,2	3	0,6
	Jumlah	0,73	13	**2,36**
	Kelemahan (*Wakness*)			
No	Pernyataan	Bobot	Rating	Skor
1	Implementasi sistem pengawetan ozon memerlukan investasi (modal) dalam peralatan dan teknologi, yang mungkin menjadi hambatan bagi masyarakat dengan sumber daya terbatas.	0,1	2	0,2
2	Keterbatasan pengetahuan masyarakat terhadap teknologi ozon	0,1	3	0,3
3	Listrik menjadi energi utama dalam penggunaan teknologi ozon untuk pengawetan pangan	0,07	1	0,07
	Jumlah	0.64	12	**1.92**

Table 4. SWOT Analysis of External Factors in the Use of Ozone Technology

	Opportunities			
Num	Opportunity	Weight	Ratings	Score
1	Certification of agricultural products that use ozone technology from related institutions	0.15	3	0.45
2	increasing consumer demand for healthy, chemical-free foods, ozone-preserved harvested products could become attractive in the market.	0.1	3	0.3
3	The existence of support and incentives from the government for the use of ozone technology can accelerate adoption by farmers.	0.19	3	0.57
4	Collaboration between information sources (Pattimura University) and community groups	0.2	3	0.6
	Amount	0.64	12	1.92
	Threats			
Num	Threat	Weight	Ratings	Score
1	The ozone production process requires energy, and dependence on energy can be a problem in areas with unstable electricity supplies.	0.08	3	0.24
2	Consumer acceptance of ozone-preserved products may be low without effective education and marketing efforts.	0.11	2	0.22
3	Other methods of food preservation are better even though they have a negative impact on health	0.17	4	0.68
	Amount	0.36	9	1.14

Based on the internal and external tables of implementing ozone technology for food security in Ambon, they will be further tabulated into internal factor attractiveness scores and external factor attractiveness scores, as shown in the following table.

Table 5. IFAS and EFAS of Ozone Utilization on *Gnetum gnemon* L. Leaf Vegetables

Internal Factor Attrative Score (IFAS)	**2.36**	**External Factor Attrative Scote (EFAS)**	**3.06**
Total Strength Score (S)	2.36	Total Chance Score (O)	1.92
Total Weakness Score (W)	0.57	Total Threat Score (T)	1.14
SW	**1.79**	**OT**	**0.78**

Based on the IFAS and EFAS tables, the implementation score of ozone technology usage is on the X-axis (1.79) and the Y-axis (0.78). These coordinates are in quadrant 1, which means it is in a very favorable situation with significant opportunities and strengths. The appropriate strategy is to support an aggressive growth policy, enabling the maximization of numerous opportunities.

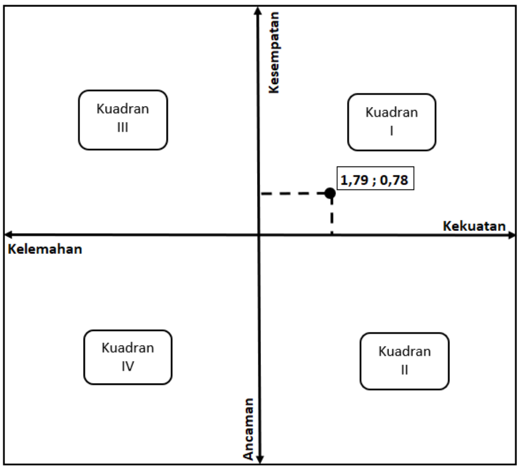

Figure 3. SWOT Quadrant

Based on the above figure, it can be seen that the quadrant is located in quadrant 1. Therefore, in implementing the use of ozone technology for food security in Ambon City, the following recommendations are made:

1. Socialization and Education

Socialization and education about ozone technology are crucial steps that need to be enhanced, especially among farmers and the general public. The main goal is to increase their awareness and understanding of the benefits and workings of ozone technology in maintaining the quality of harvests and extending their shelf life. Socialization activities can provide an understanding of the principles of a particular matter to the target audience (Latuserimala & Ansiska, 2023). The importance of this socialization lies in the fact that ozone technology has proven effective in minimizing agricultural losses due to pathogen attacks and microorganisms. With better knowledge of how ozone can efficiently clean and maintain the cleanliness of harvests and agricultural products, farmers will be able to improve the quality of their products. The general public also needs to understand the crucial role of this technology in supporting overall food security.

Socialization and education methods can be conducted through various channels. Firstly, direct counseling to farmers in the field can be an effective way to transfer knowledge directly. In this counseling, farmers can gain a deeper understanding of how ozone can be applied in their daily farming practices. Technical training also needs to be provided to ensure that farmers have the skills and sufficient knowledge to implement ozone technology correctly. Additionally, mass media serves as a highly potential tool to reach a broader audience. Disseminating information through articles, news broadcasts, and special programs can reach a wider audience, including urban communities that may not be directly involved in farming activities. Through mass media, messages about the benefits of ozone technology can be more easily understood and accepted by the general public.

The importance of this education is not only related to the individual benefits of farmers but also contributes on a larger scale, namely national sustainability and food security. With a better understanding of ozone technology, the public can better support initiatives aimed at improving agricultural productivity and reducing harvest losses. Socialization and education about ozone technology are not just educational efforts but also long-term investments in shaping a community that is more aware of the importance of innovation in agriculture. With better understanding, it is expected that the public and farmers can actively adopt ozone technology to improve agricultural yields, extend the shelf life of products, and, in turn, contribute to sustainable food security.

2. Infrastructure Development

The development of supporting infrastructure, such as ozone installation construction and skilled workforce training, is a crucial step to ensure that farmers can easily access and utilize ozone technology. Collaboration between the government and the private sector in providing these supporting facilities is essential. To support the implementation of ozone technology, establishing installations that can cover large agricultural areas is a critical step to be taken. Additionally, technical training for the workforce should also be seriously considered. The success of operating ozone installations depends significantly on the skills of the technicians responsible. Through collaboration between the government and private companies, adequate technical training can be provided to ensure that the workforce involved has a deep understanding of ozone technology, from how it works to the maintenance of the equipment used.

The government's role in encouraging infrastructure development cannot be ignored (Shortliffe et al., 1995). Collaboration with the private sector, including ozone technology and equipment manufacturers, is an effective step to ensure high standards of quality and safety in installation construction. Financing accessible to farmers should also be a serious concern so that the adoption of ozone technology can be done without imposing excessive financial burdens on them. In addition to technical and economic aspects, research and development are also crucial parts of this collective effort. The private sector can play a role in supporting innovative ozone research, creating more advanced and efficient technology. By focusing on innovation, the government and the private sector can ensure that ozone technology continues to evolve and can address complex challenges in the agricultural sector.

Collaboration between the government and the private sector is not only a form of business (Prykhodko, 2021) but also a tangible step in creating an environment that supports the growth of the agricultural sector. The success of developing supporting infrastructure for ozone technology will have a positive impact not only on agriculture but also on food security, local economies, and the overall well-being of rural communities. This is not just a mechanical project but a sincere effort to provide concrete solutions to modern agricultural challenges.

3. Product Certification

Certifying agricultural products that utilize ozone technology by competent institutions might be an effective way to enhance consumer trust in ozone-preserved harvests. Through this certification, consumers can feel confident that the product is safe and meets applicable quality standards. This is a crucial step, especially amid the widespread use of ozone technology in modern agriculture to maintain product quality and extend shelf life. With certification, the message conveyed to consumers is that the product has undergone a controlled production process and complies with strict food safety standards. The presence of certification labels not only ensures safety but also provides confidence in the quality of agricultural products that use ozone as a means to preserve the freshness of harvests.

4. Promotion and Marketing

Promotion and marketing of harvests preserved with ozone become a crucial key to raising consumer awareness of the benefits of such products. In an era where consumers are increasingly conscious of food quality and safety, effective marketing strategies can play a crucial role in shaping a positive perception of agricultural products using ozone technology. Firstly, it needs to be understood that ozone technology has proven to be effective in maintaining the quality of harvests and extending their shelf life. Therefore, involving consumers in the education process about the benefits of ozone technology is an important initial step. Promotion is not limited to introducing the product but also involves providing clear and transparent information about how ozone technology works and its positive impact on the quality of agricultural products.

The government can play a crucial role in driving these promotion and marketing efforts (Xue et al., 2010). Collaboration between the government and business entities, especially producers of ozone-preserved harvests, can be a significant asset in creating effective campaigns. Through promotional funds and policy support, the government can assist businesses in approaching the market more aggressively. Government-supported educational programs can provide consumers with more in-depth knowledge about the benefits and added value provided by ozone technology in agricultural products. Successful marketing campaigns also require active involvement from businesses and producers. They can collaborate with research institutions to generate data and case studies supporting the excellence of harvests preserved with ozone. Testimonials from farmers or producers who have directly experienced the benefits of ozone technology can also be a significant attraction in marketing campaigns. Building a strong and convincing narrative about the product's journey from the field to the consumer's table will help inspire trust.

Marketing through digital platforms can also be a highly effective means. In the digital age, consumers have broader and faster access to information. Digital campaigns can include the use of social media, websites, and specific applications to convey information to consumers. Educational videos, engaging content, and direct interactions through digital platforms can help build a community concerned with the quality of agricultural products preserved with ozone. Besides conventional promotions, the presence of products in the market needs to be reinforced. Demonstration programs at traditional markets or supermarkets provide an opportunity for consumers to try and get to know the product firsthand. This also opens up opportunities to address questions or doubts directly from consumers, helping build a closer relationship between producers and consumers.

In this context, the role of training and mentoring for farmers should not be overlooked. Farmers actively involved in using ozone technology need to be empowered to become ambassadors for their products. Training should cover not only the technical aspects of ozone use but also how to communicate the benefits of this technology to consumers. By strengthening the role of farmers as an integral part of the marketing chain, long-term success in building a market for ozone-preserved harvests is more likely. Thus, the promotion and marketing of products preserved with ozone are not only the responsibility of producers but also a strategic collaboration between the government, businesses, and farmers. With a holistic and sustainable approach, it is expected that ozone technology can garner broad consumer support, strengthen its position in the market, and ultimately have a positive impact on food security and the overall progress of the agricultural sector.

5. Government Support and Incentives

In accelerating the adoption of ozone technology by farmers, the support and incentives provided by the government play a crucial role. One effective form of support is the subsidy for the price of ozone installation. By providing this subsidy, the government can help reduce the financial burden that farmers may face in installing ozone infrastructure on their agricultural land. The subsidy may cover part or all of the installation costs, making ozone technology more affordable and accessible to farmers of various scales, including those with limited land. In addition to price subsidies, technician training is also an essential part of providing comprehensive support to farmers. The government can initiate training programs covering technical aspects, ozone equipment maintenance, and handling emergency situations that may arise during the use of this technology. Involving the private sector in organizing these training programs can ensure that technicians receive the latest and most relevant knowledge related to the developments in ozone technology.

Collaboration between the government and the private sector is crucial in organizing this support and incentives. The private sector, including ozone equipment manufacturers and providers of technical training, can provide valuable insights into the industry and direct experiences related to the implementation of ozone technology in the field. This collaboration also opens opportunities for the private sector to actively contribute to policy formation and support programs, making them more aligned with the needs and challenges faced by farmers. In addition to directly benefiting farmers, government support and incentives can create a domino effect in promoting overall growth in the agricultural sector. The adoption of ozone technology can maintain the quality of harvests, which, in turn, can increase farmers' income. Thus, this becomes not only an investment in sustainable agricultural development but also a support for national food security.

It is essential to create support and incentive mechanisms that are sustainable so that farmers not only adopt ozone technology early but also continue to implement these practices in the long term. The government needs to consider sustainability strategies and policy adjustments based on evaluations of outcomes and feedback from farmers and the private sector. Therefore, government support and incentives, especially in the form of subsidies for ozone installation prices and technician training, can be key to success in accelerating the adoption of ozone technology by farmers. Good collaboration with the private sector will ensure that the implementation of these programs aligns with field needs and supports a vision of modern, efficient, and sustainable agriculture.

DISCUSSION

Based on the conducted research, the use of ozone technology with a dosage of 3 ppm and a treatment duration of 25 minutes can maintain the freshness of *Gnetum gnemon* L. compared to those not exposed to ozone technology. The implementation strategy for ozone technology in the food resilience efforts of Ambon city can be carried out through the socialization and education of ozone technology, infrastructure development, certification of products using ozone technology in post-harvest management, promotion and marketing, and providing support and incentives from the government.

ACKNOWLEDGMENT

To enhance the implementation of ozone technology in the food resilience of Ambon city, it is recommended to conduct an intensive socialization campaign, invest in infrastructure development, provide product certification, engage in digital promotion, and receive government support through subsidies and training programs.

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